TM X 72899 Mr. Butler

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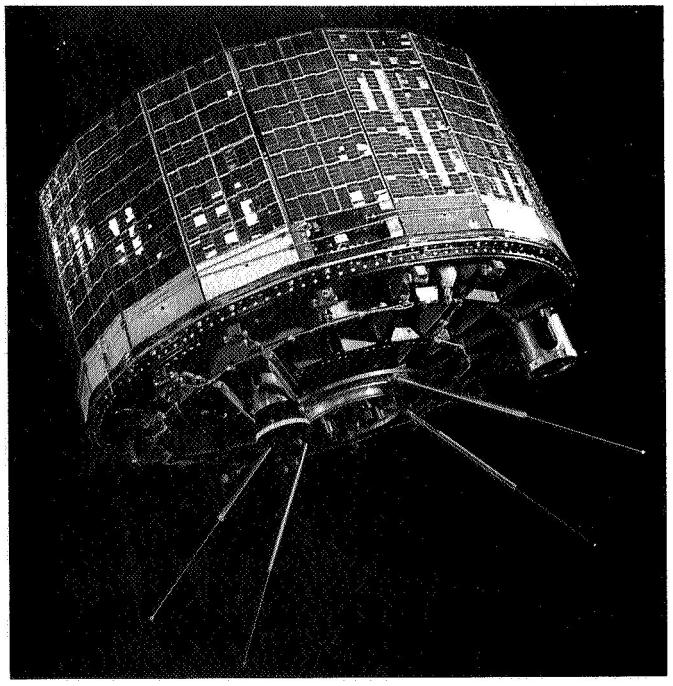
TIROS VII

DELTA 19
FLASH FLIGHT REPORT
T + 8 HOURS



prepared by

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N76-70878

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TIROS G FLASH FLIGHT REPORT T + 8 HOURS
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PROJECT DELTA 19

A-52

TIROS G

*FLASH FLIGHT REPORT

June 19, 1963

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NOTE: Because of the short period of time allowed for the publication of this report and the lack of some downrange and local data for review, some information may be incomplete or in error. The comprehensive Field Flight Report, which will be published in about 21 days, will include a detailed analysis of all data.

GODDARD SPACE FLIGHT CENTER
FIELD PROJECTS BRANCH

DELTA 19 FLASH FLIGHT REPORT

1.0 SUMMARY

1.1 The Delta 19 vehicle, consisting of three stages (359/20004/SV-355) and the A-52 (Tiros G) spacecraft, was launched on June 19, 1963 at 0450 hours, 01.89 seconds EST from Complex 17, Pad B at the Atlantic Missile Range. First and second stage performance was nominal. Third stage performance was nominal as indicated by preliminary orbital predictions. The Tiros G spacecraft was injected into the desired orbit.

1.2 The weather for the launch period was generally good. There was a maximum wind shear of 10 knots per thousand feet and maximum wind of 40 knots at 110,000 feet. Surface winds were from the southwest at 5 knots. Visibility was better than 10 miles. A stationary front existed through Georgia and a high-pressure system prevailed over Florida.

2.0 LAUNCH PREPARATIONS

2.1 F-6 Day Operations

2.1.1 The F-6 day acceptance test commenced at 0830 EST on June 10, 1963. The external power portion of the combined systems test was completed sucessfully. The following problems developed during the internal power run:

a. The first stage hydraulic system developed several minor leaks. B-nuts were retorqued and the leaks stopped.

b. A BTL "hold-fire" signal was received because of a switching error in the BTL RIME Monitor.

c. MECO was not received as a result of incorrect hook-up of the FIP depressurizing system.

d. The first stage engine and control batteries ran down and had to be replaced.

e. The first stage yaw attitude gyro drift rate was out of tolerance. (This was later adjusted on F-4 day.)

f. The second stage telemetry transmitter was off frequency and below power-output specifications. The power amplifier was replaced and frequency re-adjusted.

g. The first stage turbine inlet temperature indicator showed a 10 percent shift. The magnetic amplifier for this indicator was sent back to the T-lab for re-checkout.

h. The second stage fuel tank pressure transducer did not operate properly and was replaced.

2.2 F-3 Day Operations

2.2.1 The F-3 day combined systems test began at 1230 EST on June 13, 1963. The following problems developed during the power internal portion of the test.

a. The second stage telemetry transmitter was removed and replaced because of power fluctuations.

b. The first stage telemetry transmitter kept drifting and frequency had to be reset.

c. The first stage programmer tape ran off the spool when the programmer was returned to the ready position. This problem was traced to a broken lead in the CEA "T" cable. The tape was later replaced in the lab and the CEA was requalified in the vehicle.

2.3 F-1 Day Operations

2.3.1 The F-1 day portion of the countdown was scheduled for 0500 EST on June 17, 1963. The F-1 tasks were successfully completed at 1730 EST with all systems appearing normal.

2.4 F-0 Day Operations

2.4.1 The F-0 day countdown started at 1755 hours EST on June 17, 1963. Listed below are several problems encountered during the countdown tasks.

a. The first stage fuel fill valve leaked and had to be replaced.

b. The first stage 3.9 kc VCO was replaced.

c. A fairing separation bolt broke while being torqued. A second bolt broke in the same manner and the launch was canceled at 0400 hours EST, June 18, 1963.

2.5 Rescheduled F-0 Day Operations

2.5.1 The F-0 day countdown was rescheduled for 2150 hours EST on June 18, 1963. The fairing separation bolts were installed and torqued in accordance with a new torque value. The countdown proceeded normally until launch with no major vehicle problems.

3.0 TRAJECTORY

3.1 First Stage

Range impact charts indicated that the vehicle was high and slightly right of nominal until guidance initiation. After guidance correction the trajectory was nominal until MECO. The first stage impact point was approximately 50 nautical miles short of the expected point. The present position charts indicated that the first stage was nominal in the pitch plane and slightly right in yaw.

3.2 Second Stage

The second stage impact chart indicated that the vehicle was slightly left of nominal with the second stage impacting 50 nautical miles short of the expected point. This is attributed to the low performance of the booster.

The second stage position charts indicated that the vehicle was slightly below nominal in the pitch plane and was nominal in the yaw plane.

4.0 SEQUENCE OF EVENTS

The following event times are given in seconds after lift-off.

Event	Expected	Actual
Lift-off	T+0	
Roll Start	T+2	T+2
Roll Stop	T+9	T+9
Pitch	T+10	T+10
S/S Roll Uncage	T+14	T+14
Pitch	T+30	T+30
Pitch	T+70	T+70.2
BTL Enable	T+80	
Pitch	T+90	T+90.2
Gain Change	T+90	T+90.2
Arm Bus	T+120	T+122.1
Stop Pitch	T+130	T+130.2
MECO Enable	T+139	
MECO	T+146	T+144.4

NOTE: Because the second stage programmer is started by MECO, all second stage programmer events are referenced to the actual MECO time.

Seq. # 1	M+4	M+4
Yaw #1 In	M+6	M+6
Yaw #1 Out	M+17	M+17
Fairing Separation	M+19	M+18.9
Pitch #2 In	M+21	M+21
D_1P_2 Out	M+154.2	M+154.6
Seq. #3	M+169	M+169
BTL SECO	M+169.9	M+170.4
Coast Transfer	M+171.4	M+171.9
Pitch # 3 In	M+185	M+185
BTL Off	M+224.9	M+224.3
Pitch # 3 Out	M+285	M+285
Yaw #2 In	M+287	M+287
Yaw #2 Out	M+347	M+347
Seq. #4	M+486	M+486.1
Seq. #5	M+488	M+488.1
Seq. #5 BU	M+490	M+489.6
T/S Ign.	M+501.5	
T/S B.O.	M+543.5	
P/L T/S Sep.	T+1297.4	

5.0 PROPULSION

5.1 First Stage (359)

5.1.1 The total sea level thrust for the first stage during steady state operation was 173,500 pounds. Propellant utilization was 99.2% with an apparent fuel depletion; residual LOX aboard was indicated to be 800 pounds. The turbopump speed and GG LOX injection pressure corroborate the quoted thrust level. The turbine inlet temperature measurement was invalidated by an apparent malfunction of the thermocouple pickup.

5.1.2 Vernier engine solo performance as nominal with a 13 second burning time. Chamber pressure was 360 psia.

5.1.3 The first stage hydraulic supply pressure was normal at 3200 psia; return pressure maximum was 90 psia.

5.1.4 Burning time for the First Stage was 1.6 seconds short of the 146 seconds predicted by the DTO. Decaying fuel injection pressure resulted in a normal cutoff profile with the exception of the pump speed trace which exhibited a rise at MECO signal. This increase in pump RPM was apparently due to unloading of the fuel side of the turbopump as the fuel was depleted.

5.2 Second Stage Propulsion

5.2.1 The second stage performance was excellent. Average steady state thrust was as expected at 7450 lbs. Thrust tail-off occurred during the last 50 seconds of burning and dropped to a minimum of 5755 lbs. The chamber pressure corresponding to this minimum thrust value is 156 psia.

5.2.2 Propellant utilization was approximately 2 per cent greater than predicted (96 percent) due to a large velocity deficiency in the booster. Some 4 seconds worth of propellants remained at SECO.

5.2.3 Both the pre-pressurization and powered flight pressurization systems performed well. Helium bottle pressure at lift-off was 1640 psig and at SECO had decayed to 245 psig. Heat generator ignition occurred on time 10.4 seconds after second stage ignition signal. Bypass helium shut-off valve cycles were normal prior to lift-off occurring at approximately 30 second intervals. Only 2 cycles occurred after lift-off indicating a lower than normal bleed rate through the tank bleeds. This could be a result of partially clogged bleeds and/or aerodynamic heating.

5.2.4 The retro system operation was normal. Bottle pressure was 2250 psia and decay during the retro sequence was smooth and rapid, with 90 per cent expulsion occurring within 3 seconds.

5.2.5 The hydraulic system performance was normal. Pump discharge pressure was a constant 1045 psig to turn-off.

6.0 GUIDANCE AND CONTROLS

6.1 First Stage

6.1.1 The first stage control system performed satisfactorily. Lift-off transients as reflected in both pitch and yaw rate gyros were negligible. In the Mach 1 maximum "Q" region, maximum engine deviations were -0.5° in pitch and +0.9° in yaw. At Mach 1 there were some high frequency oscillations in the pitch and yaw rate gyros for several seconds. Hydraulic pressure was good at 3200 psia. The inverter was good at 115.2 VAC. Battery voltages were all normal. All programmed events occurred as scheduled. Vernier control after MECO was normal.

6.1.2 Initial BTL steering orders were pitch down and yaw left. Vehicle response to these commands was normal.

6.2 Second Stage

6.2.1 The second stage performed satisfactorily. The second stage roll gyro error at first/second stage separation was 2.8°, indicating a higher than usual "G" sensitive drift rate of the first stage roll gyro. Staging transients were small and easily damped.

6.2.2 Thrust misalignment during second stage powered flight was +0.25° in pitch and negligible in yaw. The usual roll moment was seen during second stage powered flight.

6.2.3 BTL powered flight steering orders were very small. Open loop steering orders were +0.2° in pitch and +0.8° in yaw. SECO was initiated by BTL and transfer to coast control was normal. Adequate limit cycles were achieved in all three control axes.

6.2.4 All programmed events occurred on time. Third stage spin rate at separation was approximately 125 rpm increasing to 133 rpm at third stage burnout. Pointing errors at second stage/third stage separation were 0.26° up in pitch and less than 0.1° right in yaw and associated rates of 0.3°/sec in pitch and yaw.

7.0 DATA AND INSTRUMENTATION

7.1 Optics

All of the 11 metric, 16 engineering sequential, and 29 documentary cameras committed to the test operated properly.

7.2 Radar

Radar coverage was good, being virtually complete out to T+733 seconds for 1.16 and T+723 seconds for 0.16. Both Mod IV radars held track until about T+120 seconds. The SPANDAR radar at Wallops was brought up at T+500 seconds and acquired but had difficulty establishing and maintaining automatic track. The 3.16 radar tracked, but had shorter coverage than the Cape radars.

7.3 Telemetry

Second stage telemetry coverage was complete from prior to liftoff through T+1174 seconds. Flame ionization effect caused less than one second of data dropout on the first stage. Tel 2, Tel 3, DAC and NASA recorded first stage data from the Cape. The Cape stations, GBI, New Hampshire, and two aircraft recorded data from the second stage. Tel 3 recorded the 136.23 and 36.92 mc spacecraft links with LOS at T+725 seconds.

7.4 ELSSE

ELSSE had satisfactory track from liftoff through T+690 seconds.

7.5 Command Destruct

No commands were necessary or sent.

7.6 Vehicle Instrumentation

Several vibration measurements were added to the first stage: engine section, 3.0 kc; interstage, 14.5 kc; center section, 22 kc; and lox tank bottom, 40 kc. Vernier Engine No. 2 chamber pressure was removed from 3.0 kc to make room for the engine section vibrometer. BTL vibrations were added to the 40 kc channel on Stage 2 and the flow meters were returned to the 22 kc channel. The 22 kc supercommutated BTL-AGC was removed. The sequence channel was removed from PDM channel 30 so that the vibration frame synchronization could be monitored. The Range Safety SECO sequence was removed from PDM channel 32 and hydraulic pressure was supercommutated on it instead. MECO was instrumented on the PDM channel 4 sequence instead of TPS cutoff. PDM channel 28, turbine inlet temperature, on Stage 1 failed during the flight, otherwise all channels functioned properly.

8.0 SPACECRAFT

8.1 The F-1 day spacecraft checkouts began at T-360 minutes at 0750 EST, Monday, June 17, 1963. Tests proceeded without incident and were concluded at 0825 EST. Test data were good and the spacecraft was determined ready for launch countdown.

8.2 F-0 day launch countdown was initiated at 1755 EST on June 17, 1963 and the spacecraft checks began at 1800 EST. The tests proceeded without incident with all data being good and were concluded at 1852 EST.

8.3 The third stage ordnance installation was begun at 2012 EST and proceeded on schedule without incident.

8.4 At 2310 EST the spacecraft was given its final inspection, was accepted by RCA, and the bulbous fairing installation was begun. The fairing installation was completed except for explosive retaining bolts (4) and the spacecraft battery charger was turned on. The fairing lights operated properly. While installing and torquing the fairing bolts

aft fairing bolt in quad 4 failed before reaching the required 620 in-lb torque value. The four bolts installed were of the new cadmium plated type rather than the nickel plated type used on previous launches. A Rockwell hardness test was run on the failed bolt and a batch of 4 back up bolts. The test revealed no significant difference between the failed bolt and other bolts. While this problem was being discussed, the spacecraft was given a final test and accepted for flight with fairing installed. This test was run between 0037 and 0045 EST, June 18, 1963. All four fairing bolts were replaced and re-torqued. The aft bolt in quad #4 again failed between 550 and 600 in-lb of applied torque. This last failure occurred at 0333 EST.

8.5 The launch was scrubbed and rescheduled for June 19, 1963 pending resolution of fairing bolt problem.

8.6 During the day of June 18, 1963, tension tests were run at PAFB to determine proper torque value for fairing bolts. A value of 325 $\pm$ 10 in-lb was decided upon.

8.7 The fairing was partially removed to inspect the two bolts in the third stage separation clamp at approximately 1800 EST on June 18, 1963. These bolts were verified to be the nickel plated type. The fairing was reinstalled and the launch countdown was begun at 2150 EST. The four fairing bolts were replaced and torqued, without incident, to 325 in-lb.

8.8 The final spacecraft tests were begun at 2330 EST. No problems occurred and tests were satisfactorily completed at 2357 EST. At 2400 EST, final inspection was completed and the spacecraft was accepted for flight. At 0100 EST, June 19, 1963 the fairing was sealed and readied for flight. The spacecraft beacons were turned on at 0410 EST June 19, 1963.

8.9 The terminal count was started at T-35 minutes at 0415 EST. The countdown proceeded without incident to lift-off at 0450:01.9 EST. The allowed launch window was 0450 to 0534 EST.

8.10 Separation of the spacecraft and third stage was recorded by the Winkfield, England Minitrack Station at 10:11.13Z. Despin of the spacecraft from approximately 130 rpm to 8.3 rpm occurred at 10:15.45Z.

8.11 The first interrogation of Tiros G was accomplished by the PMR/CDA Tracking Station at 11:37.00Z and excellent TV and IR signals were received.

8.12 The Wallops Tracking Station also interrogated Tiros G on its first orbit and excellent TV pictures were received upon direct command. All TV and IR systems have responded to command and are functioning most satisfactorily. Remote pictures were programmed at PMR on the second orbit, to be read out at the Wallops Tracking Station on the fourth orbit. The spacecraft TV remote operation will not be verified until that time.

9.0 SATELLITE TRACKING STATION

9.1 The 136.92 mc and 136.23 mc spacecraft beacons were monitored during the countdown and tracked during flight until loss of signal over the horizon at approximately + 720 seconds. The frequencies at lift-off were 136.921579 mc and 136.232322 mc. The 136.23 mc signal was used as the source for doppler measurements and all vehicle staging functions were clearly indicated on the Doppler graph. Doppler data was transmitted to GSFC, via data phone.

9.2 Event times measured from the Doppler data were:

Lift-off	0450:01.9 EST
MECO	0452:25.7
Fairing Separation	0452:44.8
SECO	0455:16.5
Spin up	0500:32.3
3rd Stage Ignition	0500:46.8
3rd Stage Burnout	0501:25.9

Spacecraft/third stage separation was reported to have occurred at 0511:03 EST.

9.3 Signals from the satellite were received at this station during its first orbital pass from 0630 to 0641:50 EST. Measurement of spin rate gave 8.33 rpm.

9.4 The satellite was designated 1963-24A and a preliminary prediction from GSFC computing center gave the following orbital elements.

Apogee	350.8 nautical miles
Perigee	333.5 nautical miles
Inclination	58.5 degrees
Period	97.4 minutes

9.5 Earlier predictions using second stage position and velocity as obtained from FPS-16 and BTL radars and assuming a nominal third stage were:

	FPS-16	BTL	Nominal
Apogee	387.09 n. mi.	335.1 n. mi.	355 n. mi.
Perigee	340.18 n. mi.	334.6 n.mi.	355 n. mi.
Inclination	58.16 deg.	58.28 deg.	58.3 deg.
Period	97.9 min.	97.09 min.	97.65 min.

10.0 PAD DAMAGE

10.1 Only normal pad damage was incurred.